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Watanabe et al.

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(54) **SHEET PROCESSING APPARATUS AND IMAGE FORMING SYSTEM**

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(30) **Foreign Application Priority Data**

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B26D 5/00 (2006.01)

(52) **U.S. Cl.**
USPC **270/58.07**

(58) **Field of Classification Search** 399/407; 270/58.07; 83/76.6–76.9, 403.1
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,746,162	A	5/1998	Hosoi et al.	
7,021,616	B2	4/2006	Mizuta et al.	
7,134,370	B2	11/2006	Murata et al.	
2007/0057446	A1	3/2007	Nishimura et al.	
2008/0122156	A1	5/2008	Fujii et al.	
2008/0307939	A1 *	12/2008	Smith	83/331
2009/0103962	A1	4/2009	Fujii et al.	
2009/0226204	A1 *	9/2009	Sasaoka et al.	399/82
2010/0158597	A1 *	6/2010	Miyake	399/407

* cited by examiner

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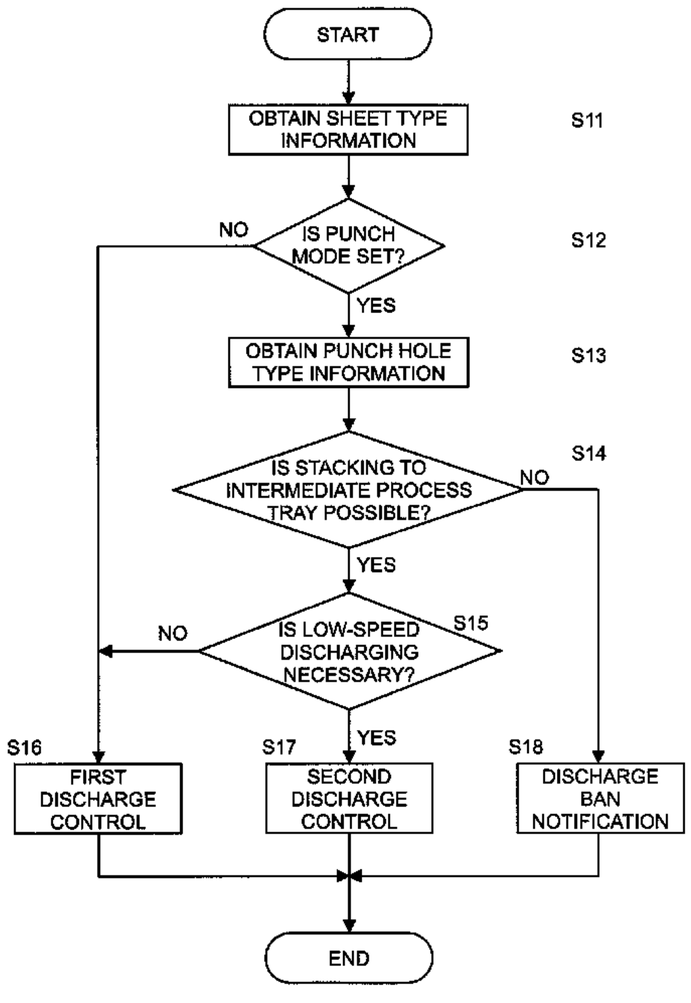
(57) **ABSTRACT**

A sheet processing apparatus includes a punch portion punching a hole at an end part of a sheet, and a push-out member discharging the sheet by pushing the end part of the sheet where the punch process is performed by the punch portion. The push-out member discharges the sheet at a sheet discharging speed lower than a predetermined speed from the intermediate process tray in accordance with punch process information (i.e., combination of a size and a type of the sheet and number, a shape and a size of holes) that strength of a sheet end part is decreased by the punch process, and is lower than predetermined sheet strength capable of being discharged at the predetermined speed.

13 Claims, 12 Drawing Sheets



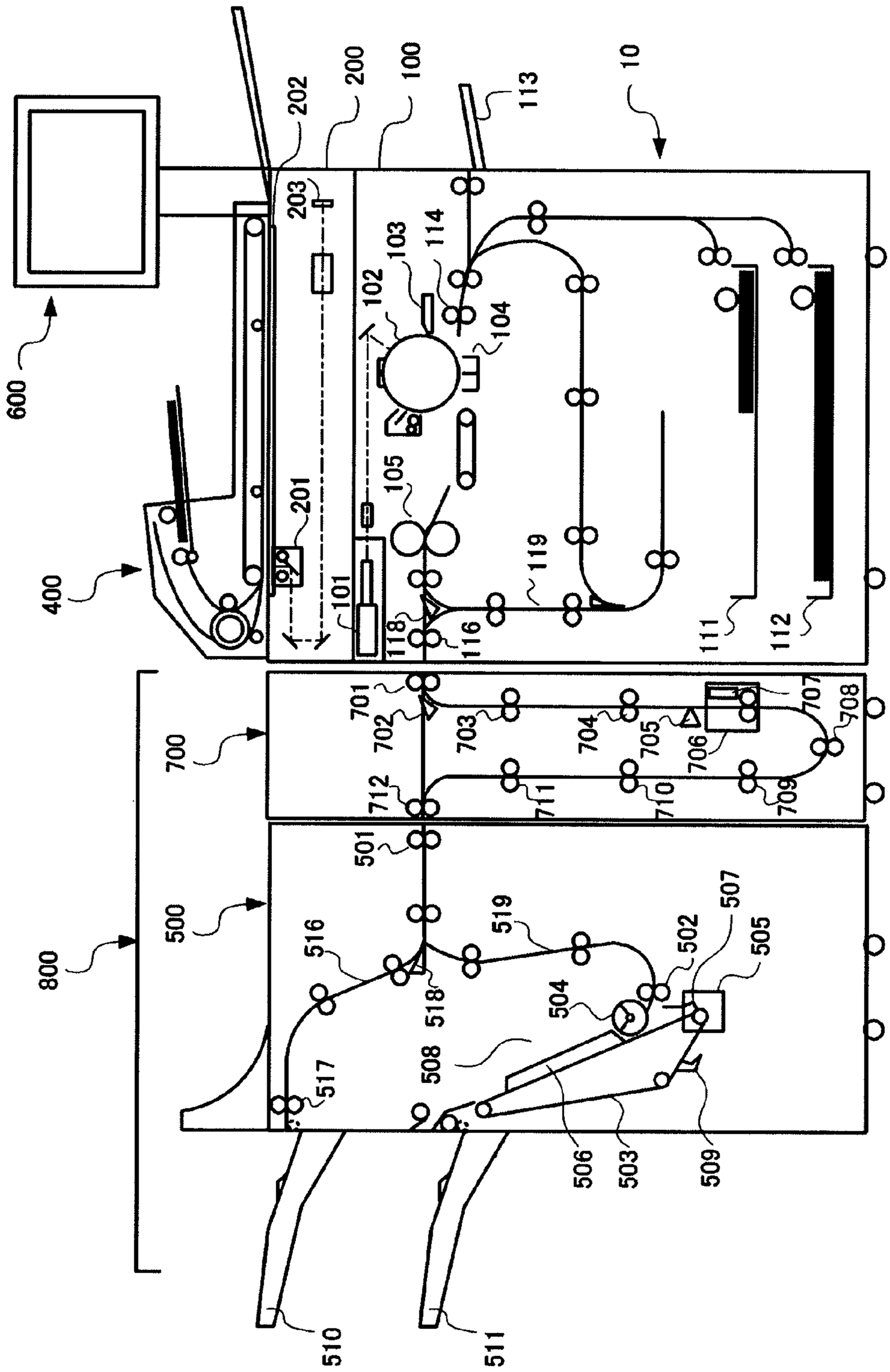

600
202
200
100
113
10
203
114
103
102
104
201
105
400
101
118
116
119
111
112
700
701
702
703
704
705
706
707
708
712
711
710
709
800
500
501
516
519
502
507
505
518
504
508
517
506
503
509
510
511

FIG. 1

FIG. 2

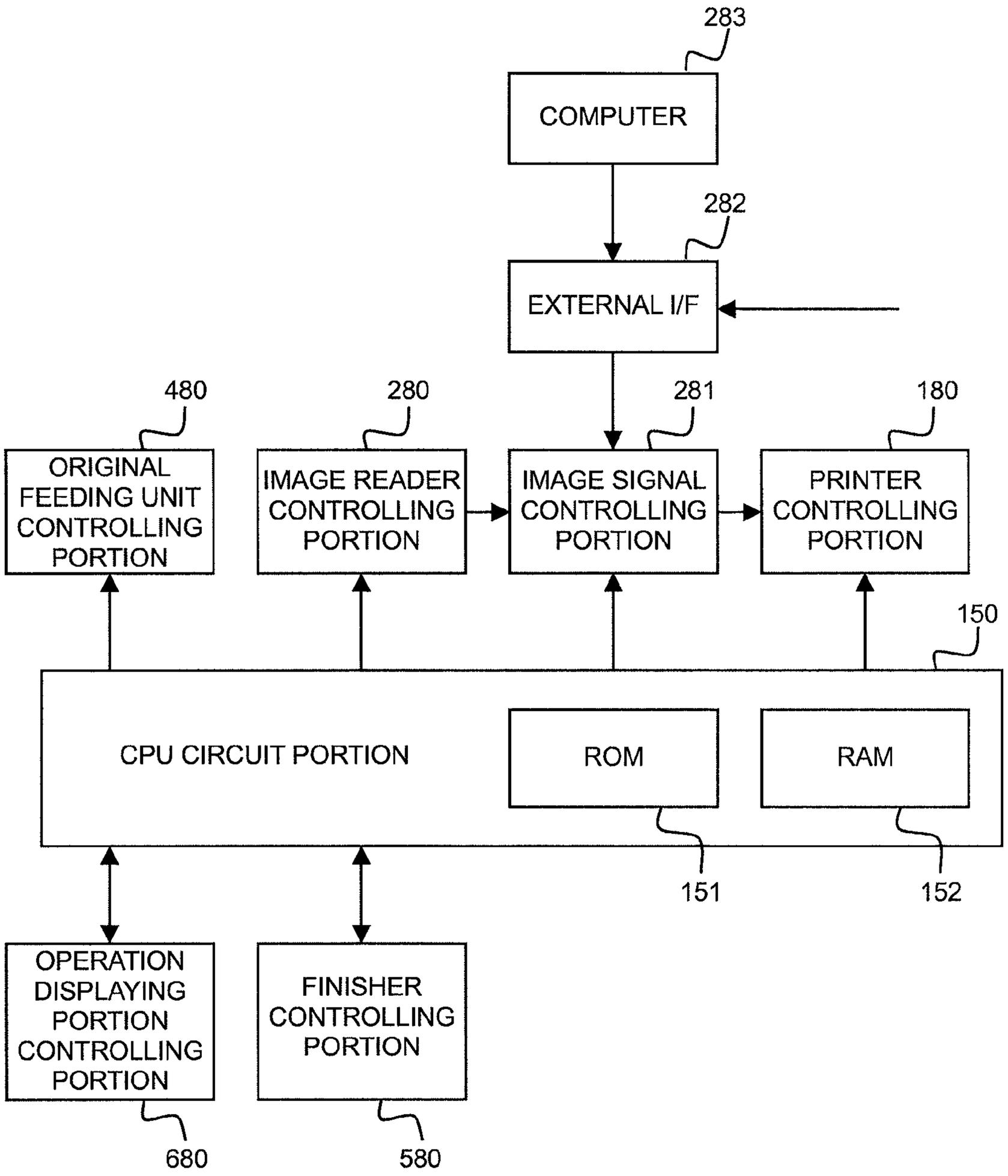

283
COMPUTER
282
EXTERNAL I/F
480
ORIGINAL FEEDING UNIT CONTROLLING PORTION
280
IMAGE READER CONTROLLING PORTION
281
IMAGE SIGNAL CONTROLLING PORTION
180
PRINTER CONTROLLING PORTION
150
CPU CIRCUIT PORTION
ROM
RAM
151
152
OPERATION DISPLAYING PORTION CONTROLLING PORTION
680
FINISHER CONTROLLING PORTION
580

FIG. 3

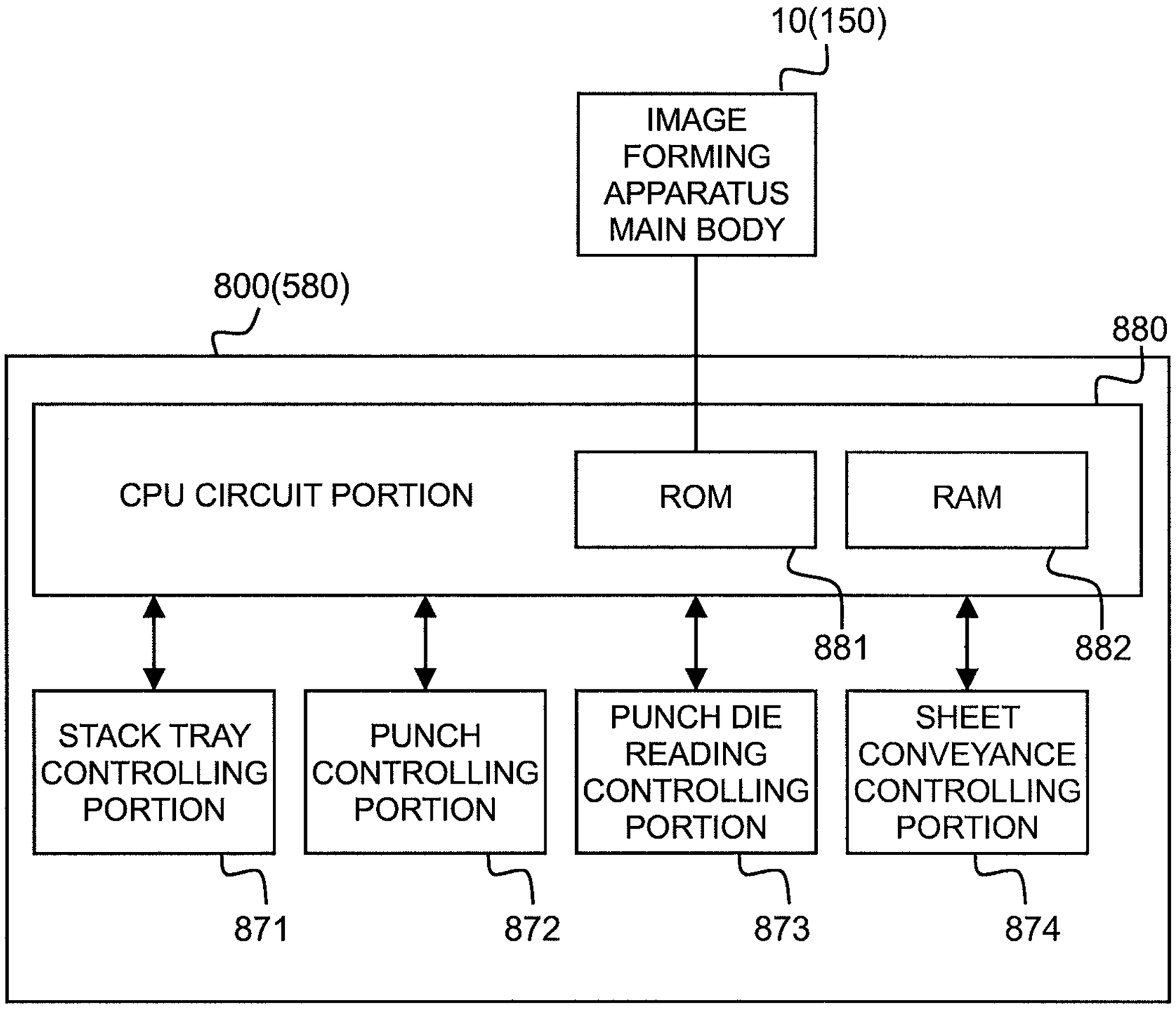

10(150)
IMAGE FORMING APPARATUS MAIN BODY
800(580)
880
CPU CIRCUIT PORTION
ROM
RAM
881
882
STACK TRAY CONTROLLING PORTION
PUNCH CONTROLLING PORTION
PUNCH DIE READING CONTROLLING PORTION
SHEET CONVEYANCE CONTROLLING PORTION
871
872
873
874

FIG. 4A

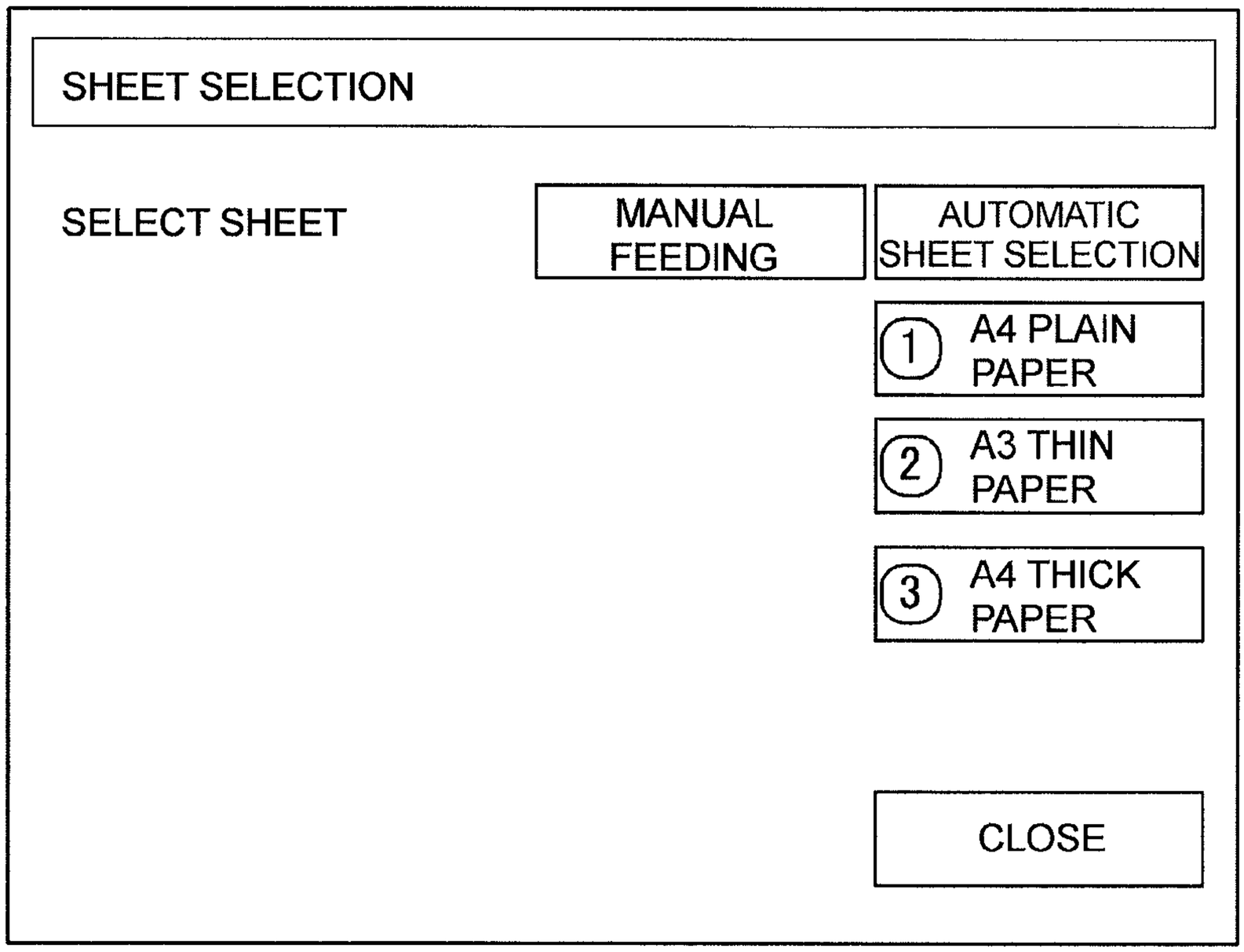

SHEET SELECTION
SELECT SHEET
MANUAL FEEDING
AUTOMATIC SHEET SELECTION
1 A4 PLAIN PAPER
2 A3 THIN PAPER
3 A4 THICK PAPER
CLOSE

FIG. 4B

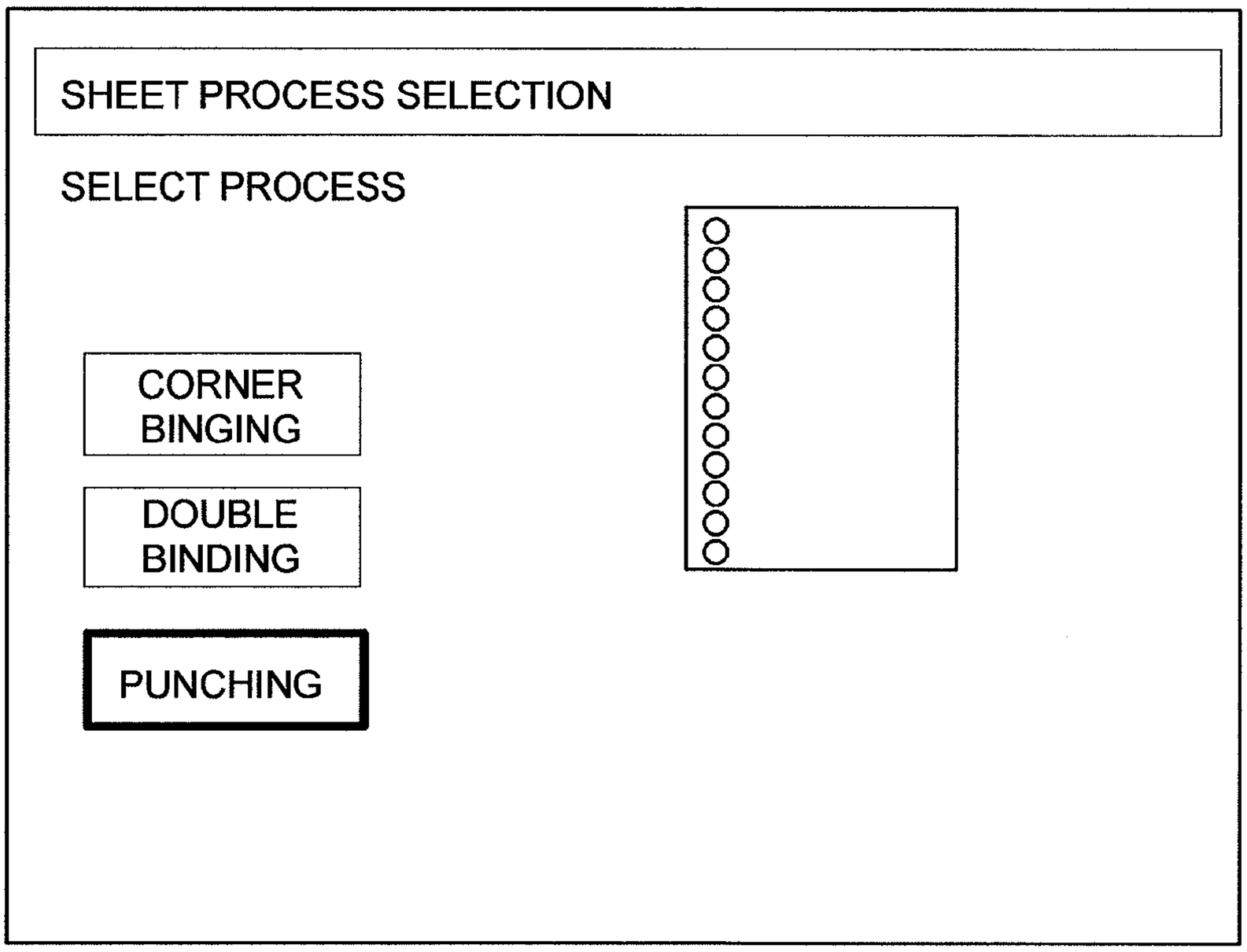

SHEET PROCESS SELECTION
SELECT PROCESS
CORNER BINGING
DOUBLE BINDING
PUNCHING

FIG. 5A

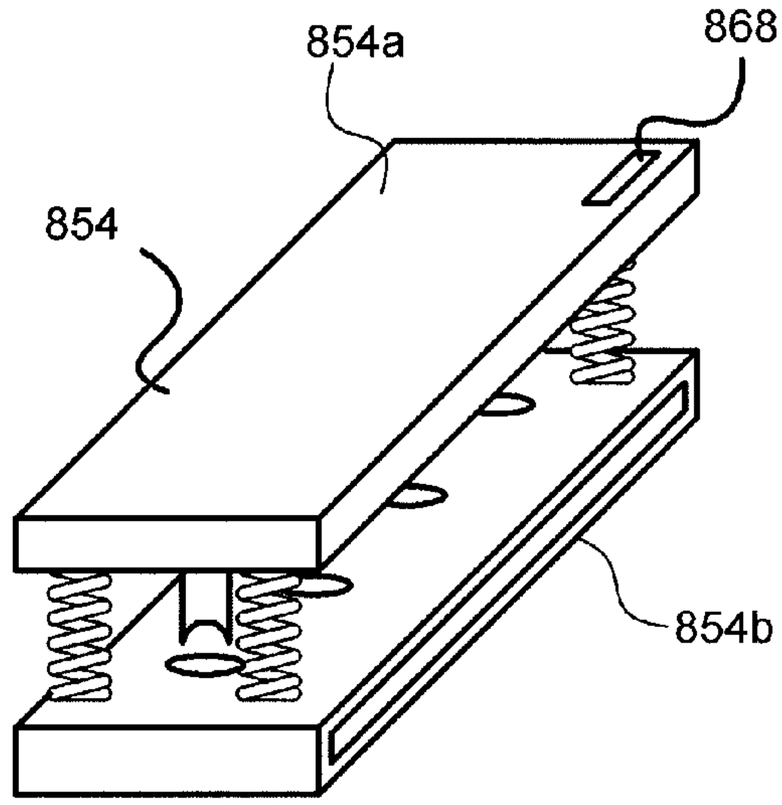


FIG. 5B

	4 HOLES	30 CIRCULAR HOLES	30 RECTANGULAR HOLES
ID	1	2	3
NUMBER OF HOLES	4	30	30
HOLE DIAMETER	8 mm	6 mm	6 mm
SHAPE	CIRCLE	CIRCLE	SQUARE

FIG. 6A

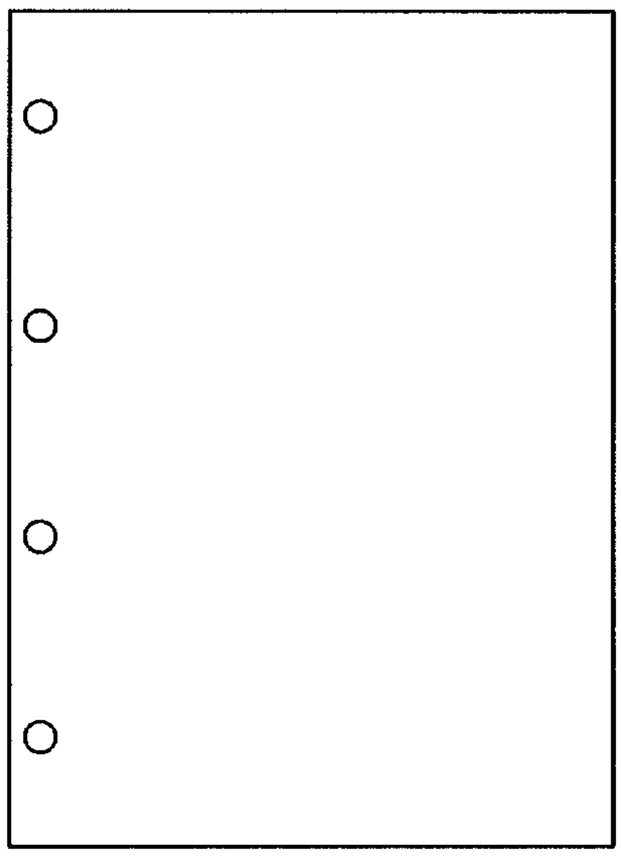


FIG. 6B

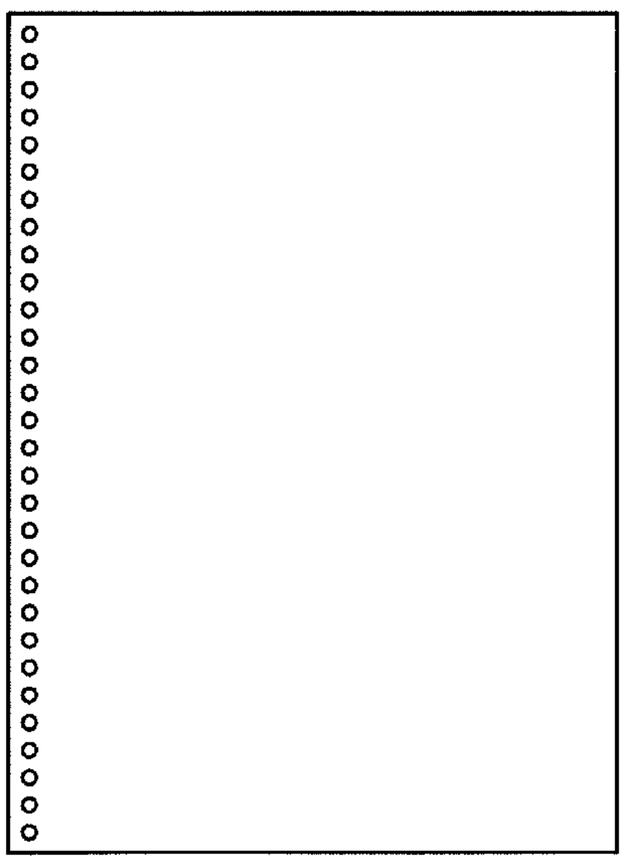


FIG. 6C

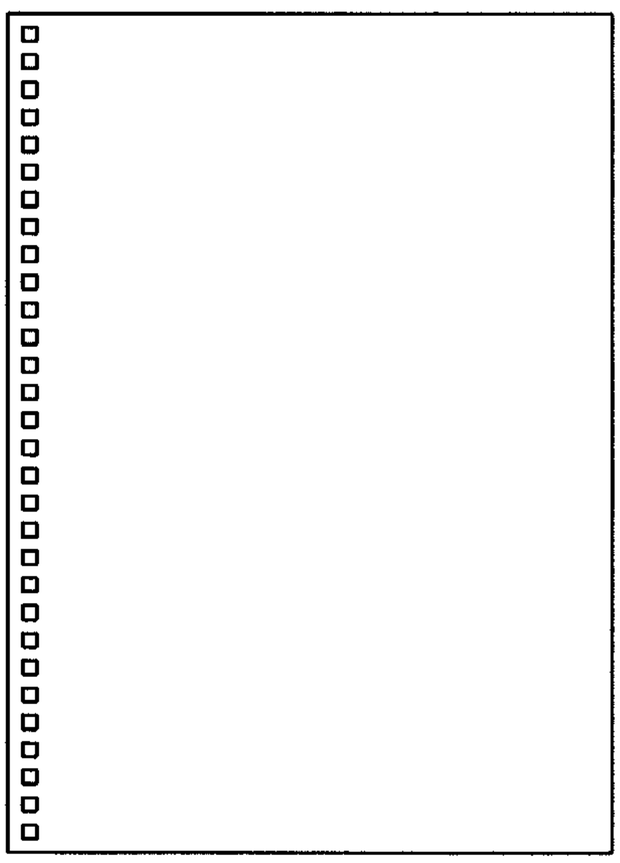


FIG. 7

	WITHOUT PUNCH			4 HOLES			30 CIRCULAR HOLES			30 RECTANGULAR HOLES		
ID	-			1			2			3		
NUMBER OF HOLES	-			4			30			30		
HOLE DIAMETER	-			8 mm			6 mm			6 mm		
SHAPE	-			CIRCLE			CIRCLE			SQUARE		
SHEET TYPE	THIN PAPER			THIN PAPER	PLAIN PAPER	THICK PAPER	THIN PAPER	PLAIN PAPER	THICK PAPER	THIN PAPER	PLAIN PAPER	THICK PAPER
SHEET DISCHARGE METHOD (LENGTH: 364 mm OR LONGER)	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	SECOND DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	DISCHARGE BAN NOTIFICATION	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL
SHEET DISCHARGE METHOD (LENGTH: SHORTER THAN 364 mm)	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	SECOND DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL

FIG. 8

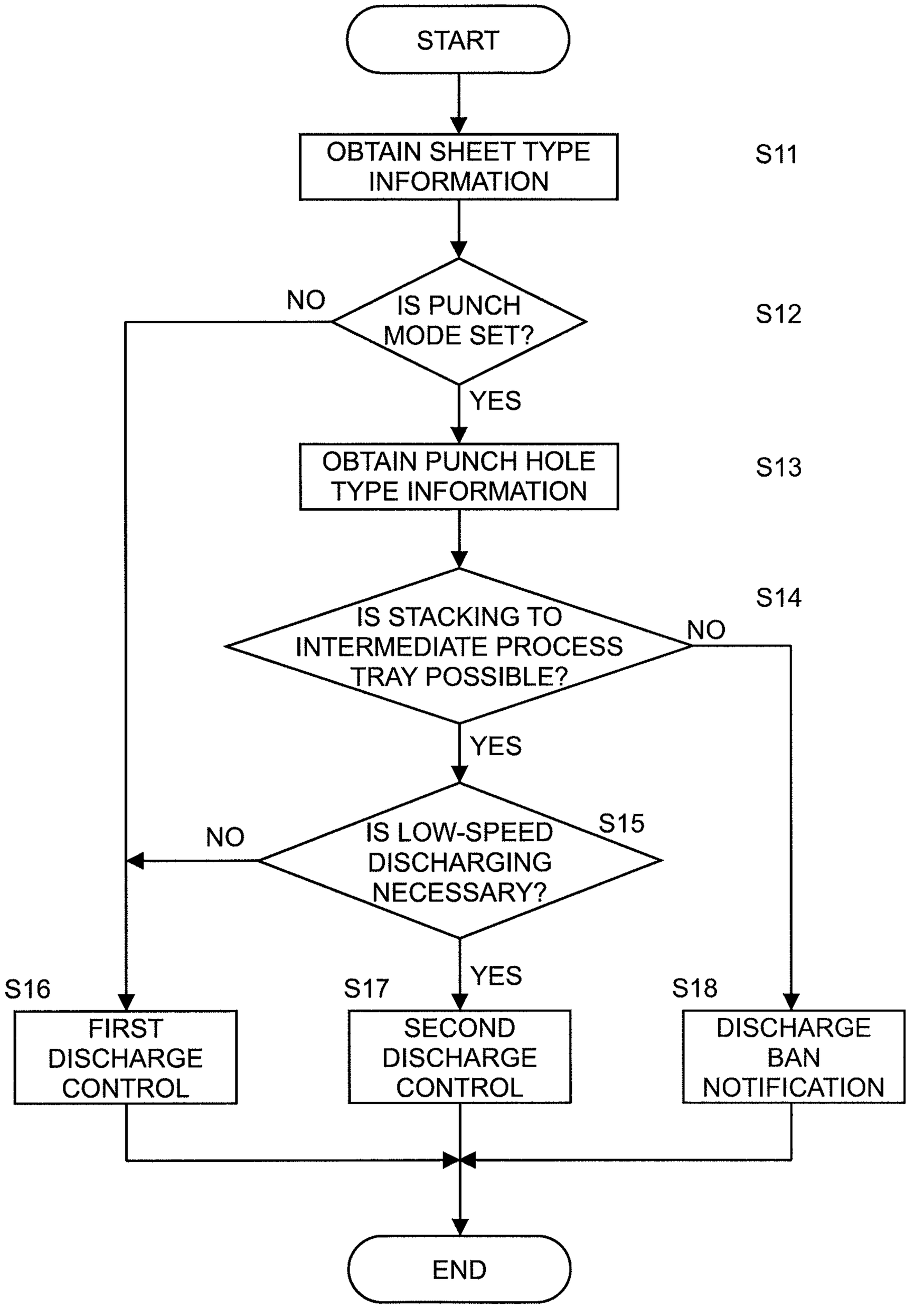
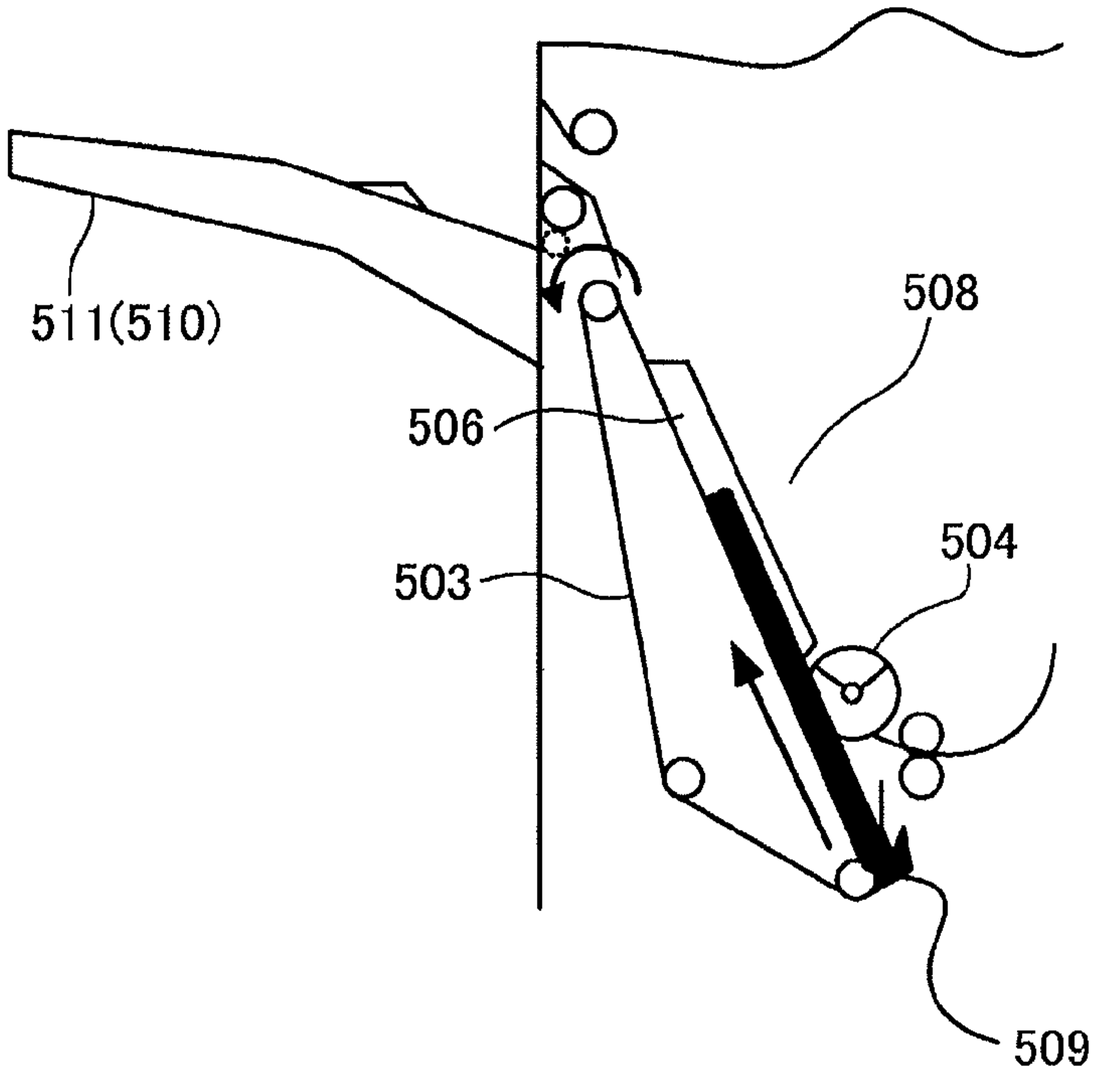

START
OBTAIN SHEET TYPE INFORMATION
S11
IS PUNCH MODE SET?
NO
S12
YES
OBTAIN PUNCH HOLE TYPE INFORMATION
S13
IS STACKING TO INTERMEDIATE PROCESS TRAY POSSIBLE?
S14
NO
YES
IS LOW-SPEED DISCHARGING NECESSARY?
S15
NO
YES
S16
FIRST DISCHARGE CONTROL
S17
SECOND DISCHARGE CONTROL
S18
DISCHARGE BAN NOTIFICATION
END

FIG. 9



[FIRST DISCHARGE CONTROL]		[SECOND DISCHARGE CONTROL]
DISCHARGE SPEED V1	>	DISCHARGE SPEED V2
DISCHARGE ACCELERATION Va1	>	DISCHARGE ACCELERATION Va2

FIG. 10

	WITHOUT PUNCH						
ID	-						
NUMBER OF HOLES	-						
HOLE DIAMETER	-						
SHAPE	-						
SHEET TYPE	THIN PAPER						
SHEET DISCHARGE METHOD (LENGTH: 364 mm OR LONGER)	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL				
SHEET DISCHARGE METHOD (LENGTH: SHORTER THAN 364 mm)	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL				

	4 HOLES						
ID	1						
NUMBER OF HOLES	4						
HOLE DIAMETER	8 mm						
SHAPE	CIRCLE						
SHEET TYPE	THIN PAPER	PLAIN PAPER	THICK PAPER	THIN PAPER	PLAIN PAPER	THICK PAPER	
SHEET DISCHARGE METHOD (LENGTH: 364 mm OR LONGER)	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	SECOND DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	
SHEET DISCHARGE METHOD (LENGTH: SHORTER THAN 364 mm)	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	

	30 CIRCULAR HOLES						
ID	2						
NUMBER OF HOLES	30						
HOLE DIAMETER	6 mm						
SHAPE	CIRCLE						
SHEET TYPE	THIN PAPER	PLAIN PAPER	THICK PAPER	THIN PAPER	PLAIN PAPER	THICK PAPER	
SHEET DISCHARGE METHOD (LENGTH: 364 mm OR LONGER)	SECOND DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	
SHEET DISCHARGE METHOD (LENGTH: SHORTER THAN 364 mm)	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	

	30 RECTANGULAR HOLES						
ID	3						
NUMBER OF HOLES	30						
HOLE DIAMETER	6 mm						
SHAPE	SQUARE						
SHEET TYPE	THIN PAPER	PLAIN PAPER	THICK PAPER	THIN PAPER	PLAIN PAPER	THICK PAPER	
SHEET DISCHARGE METHOD (LENGTH: 364 mm OR LONGER)	THIRD DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	SECOND DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	
SHEET DISCHARGE METHOD (LENGTH: SHORTER THAN 364 mm)	SECOND DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	FIRST DISCHARGE CONTROL	

FIG. 11

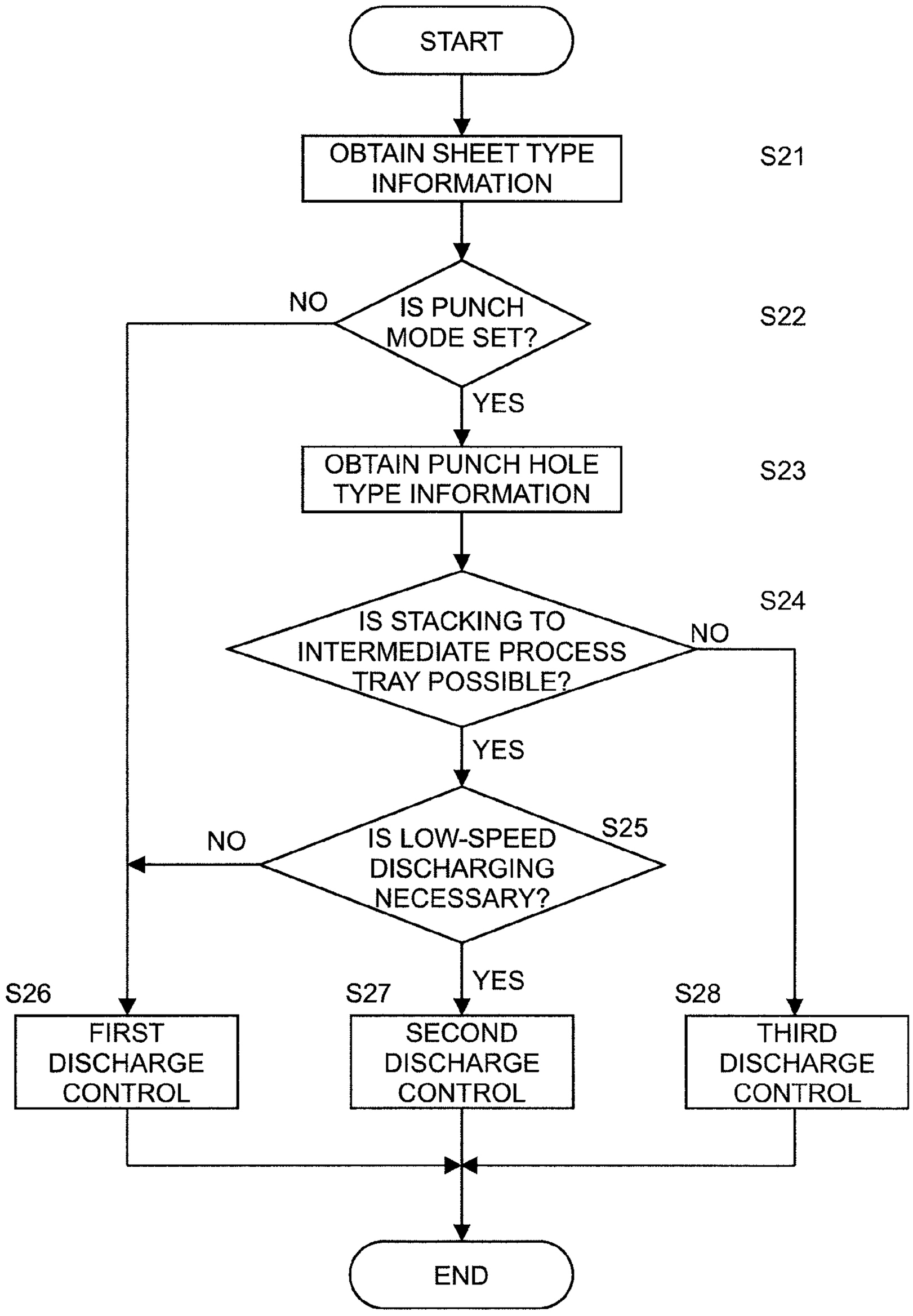
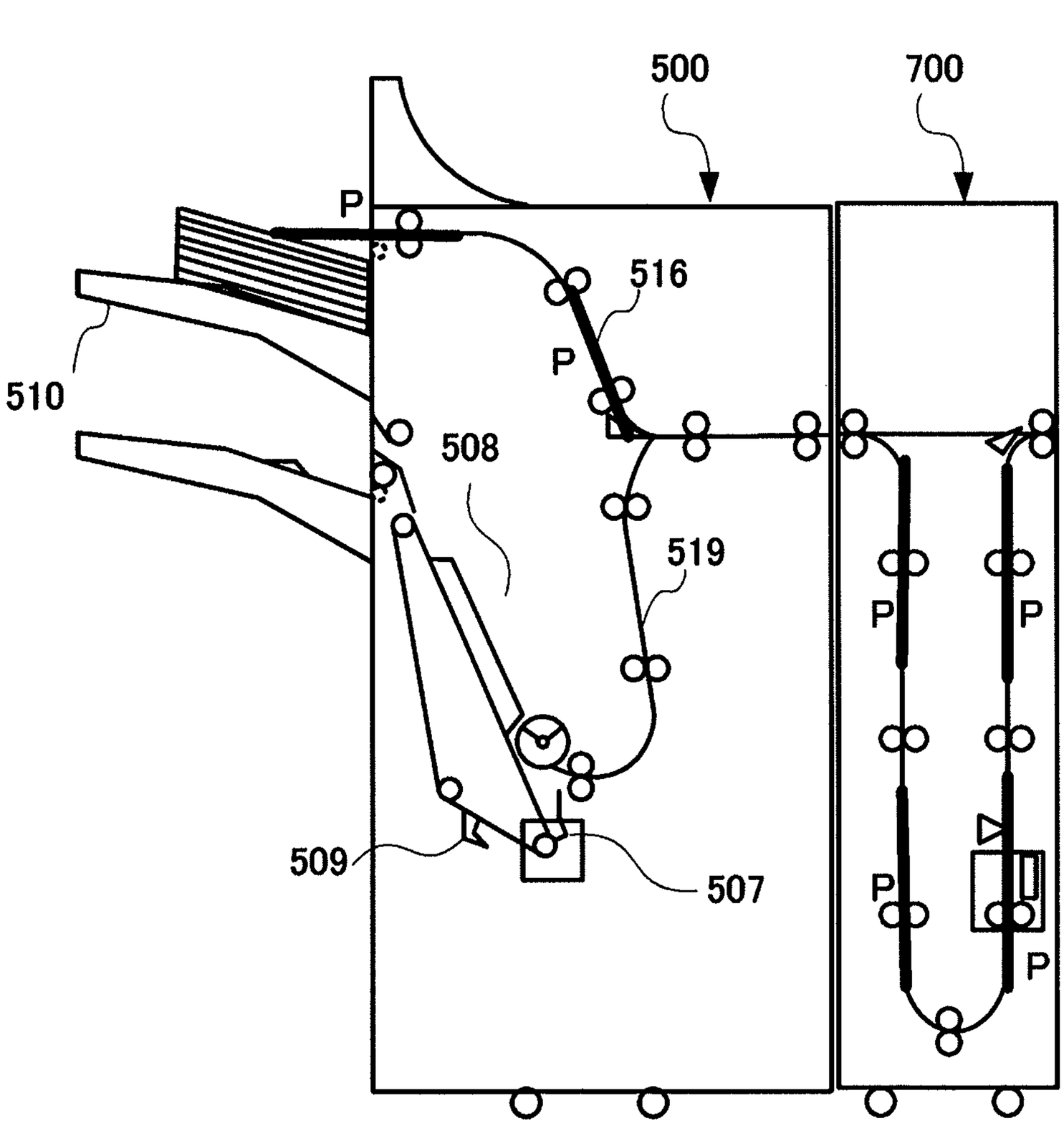

START
OBTAIN SHEET TYPE INFORMATION
S21
IS PUNCH MODE SET?
NO
S22
YES
OBTAIN PUNCH HOLE TYPE INFORMATION
S23
IS STACKING TO INTERMEDIATE PROCESS TRAY POSSIBLE?
S24
NO
YES
IS LOW-SPEED DISCHARGING NECESSARY?
S25
NO
YES
S26
FIRST DISCHARGE CONTROL
S27
SECOND DISCHARGE CONTROL
S28
THIRD DISCHARGE CONTROL
END

FIG. 12



SHEET PROCESSING APPARATUS AND IMAGE FORMING SYSTEM

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a sheet processing apparatus capable of performing a punch process on a sheet and an image forming system including the sheet processing apparatus.

2. Description of the Related Art

In the related art, there has been proposed a sheet processing apparatus in which sheets respectively having an image formed by an image forming apparatus are conveyed sequentially into an apparatus and a punch process to punch holes can be performed thereon. For example, a sheet processing apparatus on which a punch unit having different number, diameter and position of holes is exchangeably disposed to support a variety of files and rings with a single sheet processing apparatus has been proposed, as disclosed in U.S. Pat. No. 5,746,162.

Further, in the above sheet processing apparatus, punch-processed sheets are eventually discharged to a stack tray while performing a process such as aligning and stapling after being sequentially stacked on a processing tray for temporal stacking by being switched back.

With the sheet processing apparatus proposed in U.S. Pat. No. 5,746,162, when a punch process of a number of holes such as 30 holes is performed, the strength of the sheet end part of the punch-processed side is decreased. Accordingly, when the sheets are stacked on the processing tray and discharged to the stack tray from the processing tray as an ordinary punch process with a few holes such as 2 to 4 holes, there is a fear that following problems occur.

For example, sheets having the punch process of a number of holes performed at the end part thereof are sequentially stacked on the processing tray and alignment is performed by striking the end part of each punch-processed sheet to an abutment member on the processing tray after each sheet is switched back at the sheet tray.

And then, the sheets being aligned at the processing tray are discharged to the stack tray from the processing tray by being pushed by a discharge member movable along the processing tray. At that time, when the sheet is thin, there is a fear that the sheet is buckled as the discharge member pushes out the end part of the punch-processed sheet.

The present invention prevents buckling at an end part of a punch-processed sheet.

SUMMARY OF THE INVENTION

According to the present invention, there is provided a sheet processing apparatus including: a punch portion which punches a hole at an end part of a sheet; a sheet discharge portion which discharges the sheet by pushing the end part of the sheet where the punch process is performed by the punch portion; and a controller which controls the sheet discharge portion, wherein the controller controls so that the sheet discharge portion discharges a sheet at a sheet discharging speed lower than a predetermined speed in accordance with punch process information that strength of a sheet end part is decreased by the punch process and is lower than predetermined sheet strength capable of being discharged at the predetermined speed.

According to the present invention, buckling at an end part of a sheet of which strength is decreased due to a punch process can be prevented. Accordingly, a sheet product on which a high quality punch process is performed can be provided to a user.

Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a structural view of an entire image forming apparatus;

FIG. **2** is a block diagram of the image forming apparatus;

FIG. **3** is a block diagram of a finisher;

FIG. **4**A illustrates a setting screen of a sheet type and FIG. **4**B illustrates a setting screen of a process mode;

FIG. **5**A is a perspective view of a punch die and FIG. **5**B is a table which indicates types of the punch die;

FIGS. **6**A to **6**C are plane views of a sheet after performing a punch process respectively of 4 circular holes, 30 rectangular holes and 30 circular holes;

FIG. **7** is a table which indicates an example of a discharge control table according to a first embodiment;

FIG. **8** is a flowchart which describes the flow of the discharge control according to the first embodiment;

FIG. **9** is an explanatory view of a second discharge control;

FIG. **10** is a table which indicates an example of a discharge control table according to a second embodiment;

FIG. **11** is a flowchart which describes the flow of the discharge control according to the second embodiment; and

FIG. **12** is an explanatory view of a third discharge control.

DESCRIPTION OF THE EMBODIMENTS

In the following, embodiments of the present invention will be described in detail as examples with reference to the drawings. Here, dimensions, materials, shapes, relative arrangements thereof and the like described in the following embodiments are to be appropriately modified in accordance with a configuration of an apparatus to which the present invention is applied and various conditions. Therefore, the embodiments are not intended to limit the scope of the present invention only to the description unless otherwise specified.

First Embodiment

In the following, an image forming system constituted with an image forming apparatus main body and a sheet processing apparatus according to a first embodiment will be described.

General Configuration of Image Forming System

First, a general configuration of an image forming system constituted with an image forming apparatus main body and a sheet processing apparatus will be described. FIG. **1** is a schematic sectional view illustrating the general configuration of the image forming system.

As illustrated in FIG. **1**, the image forming system is constituted with an image forming apparatus main body **10** and a finisher **800** as the sheet processing apparatus. The image forming apparatus main body **10** includes an image reader **200** to read an image of an original and a printer **100** to record an image on a sheet. Further, the image forming apparatus main body **10** includes an operation displaying portion **600**. The finisher **800** is the sheet processing apparatus (i.e., sheet processing portion) selectively performing a process on an

image-formed sheet and stacking the sheet. Here, the finisher **800** includes a punch unit **700** having a punch portion capable of selectively punching different types of holes against a sheet and a staple stacker portion **500** capable of selectively performing a process on a sheet.

The image reader **200** mounts an original feeding unit **400**. The original feeding unit **400** feeds originals set faced-up on an original tray sequentially one by one from the top page and stops the original at a predetermined position on a platen glass **202** via a curved path. By performing scanning with a scanner unit **201** in this state, the original is read. At the time of scanning with the scanner unit **201**, the reading face of the original is irradiated with light of a lamp of the scanner unit **201** and the reflection light from the original is guided to a lens via a mirror. The light which passed through the lens forms an image at an imaging face of an image sensor **203**. The optically read image is output after being converted into image data by the image sensor **203**. The image data output from the image sensor **203** is input to an exposure controlling portion **101** of the printer **100** as a video signal after a predetermined process is performed with a later-mentioned image signal controlling portion **281**.

Following description is performed on a case of forming an image on one side of a sheet. At an image forming portion of the printer **100**, an exposure controlling portion **101** modulates and outputs laser light based on an input video signal. The laser light is irradiated on a photosensitive drum **102** as being scanned by a polygon mirror (not illustrated). An electrostatic latent image is formed on the photosensitive drum **102** in accordance with the scanned laser light. The electrostatic latent image on the photosensitive drum **102** is to be visible as a developer image with developer supplied from a development device **103**.

A sheet conveyed and fed to a conveying path from each cassette **111**, **112** or a manual sheet tray **113** is tentatively stopped by the top end of the sheet being struck to a registration roller **114**. Subsequently, the sheet is conveyed to a space between the photosensitive drum **102** and a transfer portion **104** at the timing synchronized with starting irradiation of the laser light. The developer image formed on the photosensitive drum **102** is transferred on the fed sheet by the transfer portion **104**. Skew of the sheet is corrected with the tentative stop by the top end of the sheet being struck to the registration roller **114**.

The sheet having the developer image transferred is conveyed to a fixing portion **105**. The fixing portion **105** fixes the developer image on the sheet by applying heat and pressure to the sheet. The sheet passing through the fixing portion **105** is discharged to the finisher **800** from the printer **100** via a discharge roller **116** by a switching member **118**. At that time, the sheet is discharged in a state that the image-formed face is faced upward (i.e., face-up).

When discharging the sheet in a state that the image-formed face is faced downward (i.e., face-down), the sheet is conveyed to a reverse path **119** as being switched back by switching the switching member **118** after passing through the fixing portion **105**. Accordingly, the sheet is reversed in the front and back and discharged to the finisher **800** from the printer **100** via the discharge roller **116**.

The sheet discharged from the printer **100** is fed to the finisher **800**. The finisher **800** is capable of selectively performing a process such as a stapling process, a punch process and a sort process on a sheet bundle. Selecting and cancelling of a stapling mode, a punch mode and a sort mode can be performed at the operation displaying portion **600**. The finisher **800** is a unit mainly constituted with the staple stacker portion **500** and includes the punch unit **700** to perform a punch process.

When the punch process is not set, the sheet discharged from the printer **100** is conveyed in the horizontal direction by a conveying roller **701** and a switching member **702** at an inlet of the punch unit **700**. Then, the sheet is conveyed to the staple stacker portion **500** by a conveying roller **501** at an inlet of the staple stacker portion **500** via a discharge roller **712**. In the case that the processes such as sorting and stapling are not set and the sheet is discharged without being processed, a switching member **518** is switched and the sheet is discharged to a stack tray **510** by a discharge roller **517** being a second sheet discharge portion via a non-sort path **516**.

Next, sheet conveyance in the case that the process such as sorting and stapling is set against the sheet will be described.

After performing image forming being similar to the case of performing image forming on one side of a sheet, the sheet is conveyed to a reverse path **119** to be switched back by switching the switching member **118** after passing through the fixing portion **105**. Accordingly, the sheet is reversed in the front and back and discharged to the finisher **800** from the printer **100** in a state of face-down. In order to perform the process on the sheet, the sheet is discharged to a bundle discharge belt **503** by the conveying rollers **501**, **502** of the finisher **800** via a sort path **519**.

To be precise, the sheet is discharged to the intermediate process tray **508** having low friction which is arranged in parallel to the bundle discharge belt **503** at a higher position by several millimeters. The discharged sheet falls under its own weight in the lower right direction along the intermediate process tray **508** (i.e., the bundle discharge belt **503**) which is obliquely arranged. The intermediate process tray **508** is a first stack portion capable of temporally stacking the sheet at the downstream side in the sheet conveying direction from a punch portion **706**. The sheet discharged to the intermediate process tray **508** is abutted with a friction member arranged at an arc of a sector-shaped return roller **504** due to rotation of the return roller **504** in the counterclockwise direction, so that the end part of the sheet is struck to a stopper plate (i.e., an abutment member) **507**. In this manner, aligning operation is performed in the longitudinal direction (i.e., the conveying direction) of the sheet.

Further, an aligning plate **506** is arranged on the intermediate process tray **508** respectively at both front and back sides. The aligning plates **506** are driven every time when a sheet is discharged onto the intermediate process tray **508**, so that the aligning operation is performed in the lateral direction (i.e., the width direction perpendicular to the conveying direction) against the sheet on the intermediate process tray **508**.

When a predetermined number of sheets are discharged and stacked on the intermediate process tray **508**, the bundle discharge belt **503** constituting a first sheet discharge portion is driven to discharge the sheet bundle. Specifically, the sheet bundle is discharged to a stack tray **510** or a stack tray **511** being a second stack portion while the rear end of the sheet bundle (i.e., the sheet end part) is pushed out by a push member (i.e., a discharge portion) **509** operated along with driving of the bundle discharge belt **503**.

When the stapling mode is set at the operation displaying portion **600**, sheets for one bundle to be stapled are discharged to the intermediate process tray **508**. After the aligning operation is performed to each sheet by the aligning plates **506**, the stapling process is performed on the sheet bundle as a stapler **505** being a processing portion is driven. Subsequently, the

sheet bundle is discharged to the stack tray **510** or the stack tray **511** by the sheet discharge belt **503**.

The stapler **505** is movable in the lateral direction and is capable of performing the stapling operation at an arbitrary position between the front and back sides against the sheets on the intermediate tray **508**. The position where the stapling process is performed is set at the operation displaying portion **600**.

Next, sheet conveyance in the case that the punch process is set against a sheet will be described.

The sheet discharged from the printer **100** is conveyed into the punch unit **700** by the conveying roller **701** and conveyed to a path of conveying rollers **703**, **704** side by switching the switching member **702** to the lower direction. When a predetermined time passes after the rear end of the sheet is detected by a sensor **705**, a roller in the punch portion **706** is stopped and a push-out plate **707** is rotated by 90°. Then, by switching back the sheet, the sheet is struck to the push-out plate **707**. Punch holes are punched at the rear end (i.e., the end part) of the sheet by the punch portion **706**. After the punch process is completed, the push-out plate **707** is returned in the direction of the original position by 90° and the roller in the punch portion **706** is driven again. Then, the sheet is conveyed to the staple stacker portion **500** by the conveying rollers **708**, **709**, **710**, **711**, **712**.

FIG. **5**A illustrates a punch die (i.e., blade portion) **854** provided at the punch portion **706** of the punch unit **700**. FIG. **5**B is a table indicating examples of types of the punch die. Although not illustrated in FIG. **1**, the punch die **854** is provided with a punch blade **854***a* and a blade rest **854***b* for punching a hole. The punch process is performed by pressing an upper part of the punch die **854** when a sheet is passing through the punch die **854**. The punch die **854** is replaceable (i.e., detachably attachable) and various hole types (i.e., the number, shape and size) of punch dies **854** are prepared.

Further, a non-contact communication IC chip (hereinafter, called the IC tag) **868** with an antenna of passive tag type is mounted on the upper part of the punch die **854**. Information of the punch die **854** is possible to be discerned by a punch die reading controlling portion **873** illustrated in FIG. **3** through communication of the IC tag **868** with a non-contact communication IC reading unit (hereinafter, called the IC tag reader; not illustrated). Here, the type of the punch die **854** is discerned by utilizing a non-contact communication IC. However, instead of non-contact communication, it is also possible to communicate with the IC tag of the punch die **854** by utilizing wired connection by drawer, for example. Instead, not utilizing a communicating portion, it is also possible to perform discrimination of punch hole types by an optical sensor as a flag being mounted on a part of the punch die **854** and a cutout of the flag being provided to the punch unit **700**.

Here, the types of the punch die **854** are exemplified with 4 circular holes, 30 circular holes and 30 rectangular holes. FIGS. **6**A to **6**C respectively illustrate a punch-processed sheet using each of the punch dies **854**. FIG. **6**A is a plane view of a punch-processed sheet using a punch die of 4 circular holes. FIG. **6**B is a plane view of a punch-processed sheet using a punch die of 30 circular holes. FIG. **6**C is a plane view of a punch-processed sheet using a punch die of 30 rectangular holes. As illustrated in FIG. **5**B, although the hole shapes are different, the number and intervals of the holes are the same between the sheets illustrated in FIGS. **6**B and **6**C.

Block Diagram of Image Forming System

Next, the configuration of a controller to perform controlling of the entire image forming system will be described with reference to FIG. **2**. FIG. **2** is a block diagram illustrating the configuration of the controller to perform controlling of the entire image forming system of FIG. **1**.

As illustrated in FIG. **2**, the controller includes a CPU circuit portion **150**. The CPU circuit portion **150** incorporates a CPU (not illustrated), a ROM **151** and a RAM **152** and generally controls respective blocks **480**, **280**, **281**, **282**, **283**, **180**, **680**, **580** with control programs stored at the ROM **151**. The RAM **152** temporally stores control data and is used as an operational area for arithmetic processing in accordance with the control.

The original feeding unit controlling portion **480** controls to drive the original feeding unit **400** based on instructions from the CPU circuit portion **150**. The image reader controlling portion **280** performs driving control against the abovementioned scanner unit **201** and the image sensor **203** and transmits the analog image signal output from the image sensor **203** to the image signal controlling portion **281**.

The image signal controlling portion **281** performs respective processes after converting an analog image signal from the image sensor **203** into a digital signal and converts the digital signal into a video signal, and then, outputs the video signal to the printer controlling portion **180**. Further, the image signal controlling portion **281** performs various processes on a digital image signal input from a computer **283** via an external I/F **282** and converts the digital image signal into a video signal, and then, outputs the video signal to the printer controlling portion **180**. The processing operation of the image signal controlling portion **281** is controlled by the CPU circuit portion **150**. The printer controlling portion **180** drives the abovementioned exposure controlling portion **101** based on the input video signals.

The operation displaying portion controlling portion **680** interchanges information with the operation displaying portion **600** and the CPU circuit portion **150**. The operation displaying portion **600** includes a plurality of keys to set various functions regarding image forming and a display portion to display information indicating a setting state. The operation displaying portion **600** displays corresponding information based on the signal from the CPU circuit portion **150** while outputting a key signal corresponding to operation of each key to the CPU circuit portion **150**.

The finisher controlling portion **580** interchanges information with the CPU circuit portion **150** based on the information set from the operation displaying portion **600** and controls the finisher **800** in accordance with a sheet size and processing details.

The CPU circuit portion **150** performs a configuration when power is turned on and obtains each structural information by communicating with the original feeding unit controlling portion **480**, the image reader controlling portion **280**, the printer controlling portion **180** and the finisher controlling portion **580**.

Next, setting procedure of the punch mode and sheets will be described. FIGS. **4**A and **4**B respectively illustrate a setting screen of a process mode (i.e., sheet selection and sheet processing selection) displayed at the operation displaying portion **600**. Sheets to be used and punch holes can be selected therefrom.

When sheets to be used are selected from the screen of FIG. **4**A, the CPU circuit portion **150** memorizes the sheet size and the sheet type to be used. On the screen of FIG. **4**B, it is possible to set the stapling process or the punch process. When "Punch" is selected as illustrated in FIG. **4**B, the CPU circuit portion **150** determines to perform the punch process. The size and type of the sheets and punch process information such as with-or-without performing punching set at FIGS. **4**A

and 4B are notified to the finisher controlling portion **580**. The finisher **800** performs a process based on the notified information.

Block Diagram of Finisher

Next, the configuration of the finisher controlling portion **580** to control the finisher **800** will be described with reference to FIG. **3**. FIG. **3** is a block diagram illustrating the configuration of the finisher controlling portion **580** of FIG. **2**.

As illustrated in FIG. **3**, the finisher controlling portion **580** being a controller is constituted with a CPU circuit portion **880**, a ROM **881** and a RAM **882**. The CPU circuit portion **880** performs data exchange by communicating with the CPU circuit portion **150** disposed at the image forming apparatus main body **10**. Then, based on the instructions from the CPU circuit portion **150**, the CPU circuit portion **880** generally controls respective blocks **871**, **872**, **873**, **874** of the finisher **800** by executing various programs stored at the ROM **881**.

In accordance with the sheet size, the sheet type and processing details notified from the finisher controlling portion **580**, a stack tray controlling portion **871** controls lifting and lowering of the stack trays **510**, **511**. In description of the present embodiment, the finisher controlling portion **580** (i.e., the CPU circuit portion **880**) is configured to communicate with the CPU circuit portion **150** disposed at the image forming apparatus main body **10**. However, it is also possible that the CPU circuit portion **150** is configured to directly control the finisher **800**.

A punch controlling portion **872** controls the punch unit **700** corresponding to the information of with-or-without performing punching notified from the finisher controlling portion **580**.

A punch die reading controlling portion **873** controls the IC tag reader to perform reading of the information of the punch die **854** (i.e., the IC tag **868**) when a punch die presence detecting sensor (not illustrated) detects mounting of the punch die **854**. The read information of the punch die **854** (for example, as indicated in FIG. **5**B) is stored to the RAM **882**. Here, the information such as an ID of the punch die, number, diameter and shape of holes is obtained. For example, in the case of the punch die of 4 holes, the ID is 1, the number of holes is 4, the hole diameter is 8 mm, and the shape is circular.

A sheet conveyance controlling portion **874** controls sheet conveyance in accordance with the sheet size and the sheet type notified from the finisher controlling portion **580**. In addition, the sheet conveyance controlling portion **874** also performs sheet discharge control to switch the sheet discharge method corresponding to with-or-without performing the punch process, the punch hole type and the sheet type.

Sheet Discharge Control of Finisher

Next, the sheet discharge control at the finisher **800** will be described with reference to FIGS. **7** and **8**. FIG. **7** is a table indicating an example of the sheet discharge control according to the first embodiment. FIG. **8** is a flowchart describing the flow of the sheet discharge control according to the first embodiment.

As described above, when the sheet having the punch process of a number of holes performed is thin and large-sized, the strength of the sheet is decreased at the end part thereof where the punch process is performed. Therefore, there is a fear that the sheet is buckled by pushing out the sheet end part where the punch process is performed by the push-out member **509**. Further, if the sheet having the punch process of a number of holes performed is thin, when the sheets are sequentially stacked on the intermediate process tray **508**, there is a fear that the sheet end part is buckled due to abutment against the stopper plate **507**.

Whether or not these problems occur is determined according to combination of punch process information such as with-or-without performing the punch process, a type of punch holes, a sheet size and a sheet type. Based on the punch process information, the sheet discharge control is performed in accordance with strength decrease at the sheet end part where the punch process is performed. In the following, the sheet discharge control is described with two examples.

First Discharge Control

The first discharge control is for the case that sheet buckling does not occur regardless of with-or-without performing punching, when a sheet having a predetermined strength or higher capable of being discharged at a predetermined speed is stacked to the intermediate process tray **508** or is stacked to the stack tray via the intermediate process tray **508**. This control is normal discharge control to discharge a sheet to the stack tray **510** or the stack tray **511** at the predetermined discharge speed via the intermediate process tray **508**.

Second Discharge Control

The second discharge control is for preventing sheet buckling occurrence at the time of discharging a sheet to a stack tray from the intermediate process tray **508** even though buckling does not occur when the sheet having the punch process performed is stacked to the intermediate process tray **508**. This control is the discharge control to discharge the punch-processed sheet which may have the abovementioned buckling toward the outside of the apparatus by the push-out member **509** constituting the first sheet discharge portion at the set speed of sheet discharging from the intermediate process tray **508** to be lower than the predetermined speed. Here, the predetermined speed refers to discharge speed V**1** or discharge acceleration Va**1** generated by the push-out member **509**, as illustrated in FIG. **9**. In the second discharge control, the discharging is performed at discharge speed V**2** or at discharge acceleration Va**2** being respectively lower than the discharge speed V**1** or the discharge acceleration Va**1** (i.e., V**1**>V**2**, Va**1**>Va**2**).

Notification of Not Permitting Discharge

Here, in the case that the end part of a punch-processed sheet is buckled by being abutted to the stopper plate **507** when being stacked to the intermediate process tray **508**, it is notified that the sheet discharge process via the intermediate process tray **508** is not permitted. In other words, not permitting to perform the sheet alignment process in the longitudinal direction (i.e., the conveying direction) of the sheet by striking the punch-processed sheet end part to the stopper plate **507** (i.e., an abutment member) is notified. Since the notification is determined corresponding to the conditions of the punch process information at the time of sheet selection and sheet processing selection by utilizing the screen of FIG. **4**, the notification is performed to the operation displaying portion **600** of FIG. **1** (or to a computer being an external host unit) in accordance with the conditions.

The discharge control is determined from the above two corresponding to a discharge control table prepared on the conditions of the punch process information where the strength of the end part of the punch-processed sheet is decreased. Here, the discharge control is determined corre-

sponding to the discharge control table prepared by combination of with-or-without performing punching, a punch hole type, a sheet size and a sheet type, as illustrated in FIG. **7**. The discharge control table illustrated in FIG. **7** is simply an example and the present invention is not limited to this.

In FIG. **7**, combinations of a size and a type of sheets and number, a shape and a size of punch holes are exemplified as the punch process information relating to strength decrease of the end part of the punch-processed sheet. Here, B4 size (i.e., the length in the sheet discharge direction is 364 mm) is exemplified as the predetermined size of the sheet. The sheet type is referred to sheet thickness. Here, plain paper is exemplified as a predetermined thickness. In this example, thick paper is thicker and thin paper is thinner than the plain paper. The number of holes, the hole diameter (i.e., the size) and the hole shape are exemplified as the hole information.

The sheet having 4 circular holes has the predetermined strength or higher capable of being discharged at the predetermined speed and receives no influence by the punch process. Accordingly, as indicated in the discharge control table of FIG. **7**, the first discharge control being the same without the punch process is performed in all combinations.

In the case of the sheet of thin paper having 30 circular holes and length of B4 (=364 mm) or longer, the sheet has the first strength being lower than the predetermined strength. With this strength, the end part of the punch-processed sheet is not buckled when being abutted to the stopper plate **507** but is buckled when being pushed by the push-out member **509** at the predetermined speed. Accordingly, with the sheet of such combination, the sheet is discharged by the push-out member at the speed of being discharged from the intermediate process tray **508** being lower than the predetermined speed (i.e., the second discharge control). Even in the case of the sheet having 30 circular holes and length of B4 (=364 mm) or longer, the sheet of plain paper or thick paper has the predetermined strength or higher capable of being discharged at the predetermined speed and the end part of the punch-processed sheet is not buckled. Accordingly, the sheet is discharged by the push-out member driven at the predetermined speed (i.e., the first discharge control). Further, in the case of the sheet having 30 circular holes and length shorter than B4 (=364 mm), the sheet even of thin paper has the predetermined strength or higher capable of being discharged at the predetermined speed not to be buckled. Accordingly, the sheet is discharged by the push-out member driven at the predetermined speed (i.e., the first discharge control).

In the case of the sheet of thin paper having 30 rectangular holes and length of B4 (=364 mm) or longer, the sheet has the second strength being lower than the predetermined strength. With this strength, the end part of the punch-processed sheet is buckled when being abutted to the stopper plate **507** of the intermediate process tray **508**. Accordingly, with the sheet of such combination, it is notified to a user via the operation displaying portion **600** that the sheet discharge process via the intermediate process tray **508** is not permitted (i.e., notification of not permitting discharge). Even in the case of the sheet having 30 rectangular holes and length of B4 (=364 mm) or longer, the sheet of plain paper or thick paper has the predetermined strength or higher capable of being discharged at the predetermined speed and the end part of the punch-processed sheet is not buckled. Accordingly, the sheet is discharged by the push-out member driven at the predetermined speed (i.e., the first discharge control).

In the case of the sheet of thin paper having 30 rectangular holes and length shorter than B4 (=364 mm), the sheet has the first strength being lower than the predetermined strength. With this strength, the end part of the punch-processed sheet is not buckled when being abutted to the stopper plate but is buckled when being pushed by the push-out member at the predetermined speed. Accordingly, with the sheet of this combination, the sheet is discharged by the push-out member at the speed of being discharged from the intermediate process tray being lower than the predetermined speed (i.e., the second discharge control). Even in the case of the sheet having 30 rectangular holes and length shorter than B4 (=364 mm), the sheet of plain paper or thick paper has the predetermined strength or higher capable of being discharged at the predetermined speed and the end part of the punch-processed sheet is not buckled. Accordingly, the sheet is discharged by the push-out member driven at the predetermined speed (i.e., the first discharge control).

Here, although the discharge control table is prepared with the combinations of three hole types of the punch die **854**, two sheet sizes and three sheet types, the combinations are not limited thereto. For example, it is also possible to classify the sheet types more finely by grammage and sheet length and to combine the types.

Next, the sheet discharge control of the finisher **800** will be described with reference to a flowchart of FIG. **8**. In the following description, the punch process information refers to combinations of information of sheet types, information of with-or-without performing punch process and information of punch holes.

In S**11**, when sheet passing is started, the finisher controlling portion **580** (i.e., the CPU circuit portion **880**) of the finisher **800** obtains sheet type information such as the sheet size and the sheet type which are set at the sheet selection screen of the operation displaying portion **600** of FIG. **4**A through the communication with the CPU circuit portion **150**. Then, it proceeds to S**12**.

In S**12**, the finisher controlling portion **580** of the finisher **800** obtains the information of with-or-without performing the punch process set at the sheet process selection screen of the operation displaying portion **600** of FIG. **4**B through the communication with the CPU circuit portion **150**. When the punch process is to be performed, it proceeds to S**13**. When the punch process is not to be performed, it proceeds to S**16** and the sheet discharge method is determined to be the first discharge control.

In S**13**, the information from the punch die reading controlling portion **873** is obtained and the hole types (the number, shape and size of holes) of the punch process to be performed are determined.

In S**14**, it is determined whether or not buckling occurs when stacking to the intermediate process tray **508** corresponding to the combination of the obtained sheet type, information of with-or-without performing the punch process and the punch hole type information. When the combination is not for causing buckling, it proceeds to S**15**. When the combination is for causing buckling, it is notified to the operation displaying portion **600** that the sheet discharge process is not permitted, as proceeding to S**18**.

In S**15**, it is determined whether or not discharging in low speed for buckling prevention is necessary when the sheet is discharged from the intermediate process tray **508** corresponding to the combination of the obtained sheet type, information of with-or-without performing the punch process and the punch hole type information. If necessary to discharge in low speed, the sheet discharge method is determined to be the second discharge control, as proceeding to S**17**. If not necessary to discharge in low speed, the first discharge control as the sheet discharge method in the case of not performing the punch process is determined, as proceeding to S**16**.

With the abovementioned steps, an appropriate sheet discharge method is determined corresponding to the combination of the sheet type, information of with-or-without performing the punch process and the punch hole type information. Accordingly, appropriate sheet control is performed in accordance with strength decrease at the end part of the punch-processed sheet, so that buckling can be prevented at the end part of the sheet having decreased strength due to punch processing. In this manner, a sheet product on which a high quality punch process is performed can be provided to a user.

Second Embodiment

Next, an image forming system constituted with an image forming apparatus main body and a sheet processing apparatus according to a second embodiment will be described. Here, since the general configuration of the image forming system is substantially the same as the abovementioned embodiment, only the sheet discharge control of the finisher will be described in the following.

Sheet Discharge Control of Finisher

Next, the sheet discharge control at the finisher **800** will be described with reference to FIGS. **10** and **11**. FIG. **10** is a table indicating an example of the sheet discharge control according to the second embodiment. FIG. **11** is a flowchart describing the flow of the sheet discharge control according to the second embodiment.

In the description of the above embodiment, two sheet discharge controls are performed in accordance with decrease of the strength at the end part of the punch-processed sheet based on the punch process information as an example. In the present embodiment, the sheet discharge control includes the following three controls as an example.

Since the first discharge control and the second discharge control are substantially the same as those in the above embodiment, only the third discharge control will be described in the following.

Third Discharge Control

The third discharge control is for the case that buckling occurs due to contact of the end part of the punch-processed sheet to the stopper plate **507** when the punch-processed sheet is stacked to the intermediate process tray **508**. The control is the discharge control to discharge the punch-processed sheet which may have the abovementioned buckling toward the outside of the apparatus by the discharge roller **517** being the second sheet discharge portion using the non-sort path **516** not by way of the intermediate process tray **508**, as illustrated in FIG. **12**. Here, the sheet is discharged to the stack tray **510**. Although the discharging is performed through the non-sort path **516**, the discharge method is not limited to the above as long as being not by way of the intermediate process tray **508**.

The discharge control is determined from the above three corresponding to a discharge control table prepared on the conditions of the punch process information where the strength of the end part of the punch-processed sheet is decreased. Here, the discharge control is determined corresponding to the discharge control table prepared by combination of with-or-without performing punching, a punch hole type, a sheet size and a sheet type, as illustrated in FIG. **10**. The discharge control table illustrated in FIG. **10** is simply an example and the present invention is not limited to this.

In FIG. **10**, combinations of a size and a type of sheets and number, a shape and a size of punch holes are exemplified as the punch process information relating to strength decrease of the end part of the punch-processed sheet. Here, B4 size (i.e., the length in the sheet discharge direction is 364 mm) is exemplified as the predetermined size of the sheet. The sheet type is referred to sheet thickness. Here, plain paper is exemplified as a predetermined thickness. In this example, thick paper is thicker and thin paper is thinner than the plain paper. The number of holes, the hole diameter (i.e., the size) and the hole shape are exemplified as the hole information.

Since the sheet having 4 circular holes receives no influence by the punch process, the first discharge control being the same without the punch process is performed in all combinations, as indicated in the discharge control table of FIG. **10**.

In the case of the sheet of thin paper having 30 circular holes and length of B4 (=364 mm) or longer, the sheet has the first strength being lower than the predetermined strength. With this strength, the end part of the punch-processed sheet is not buckled when being abutted to the stopper plate of the intermediate process tray but is buckled when being pushed by the push-out member. Accordingly, with the sheet of this combination, the sheet is discharged by the push-out member at the speed of being discharged from the intermediate process tray being lower than the predetermined speed (i.e., the second discharge control). Even in the case of the sheet having 30 circular holes and length of B4 (=364 mm) or longer, the sheet of plain paper or thick paper has the predetermined strength or higher capable of being discharged at the predetermined speed and the end part of the punch-processed sheet is not buckled. Accordingly, the sheet is discharged by the push-out member driven at the predetermined speed (i.e., the first discharge control). Further, in the case of the sheet having 30 circular holes and length shorter than B4 (=364 mm), the sheet even of thin paper has the predetermined strength or higher capable of being discharged at the predetermined speed not to be buckled. Accordingly, the sheet is discharged by the push-out member driven at the predetermined speed (i.e., the first discharge control).

In the case of the sheet of thin paper having 30 rectangular holes and length of B4 (=364 mm) or longer, the sheet has the second strength being lower than the predetermined strength. With this strength, the end part of the punch-processed sheet is buckled when being abutted to the stopper plate of the intermediate process tray. Accordingly, with the sheet of this combination, the sheet is discharged by the discharge roller **517** using the non-sort path **516** not by way of the intermediate process tray (i.e., the third discharge control). Even in the case of the sheet having 30 rectangular holes and length of B4 (=364 mm) or longer, the sheet of plain paper or thick paper has the predetermined strength or higher capable of being discharged at the predetermined speed and the end part of the punch-processed sheet is not buckled. Accordingly, the sheet is discharged by the push-out member driven at the predetermined speed (i.e., the first discharge control).

In the case of the sheet of thin paper having 30 rectangular holes and length shorter than B4 (=364 mm), the sheet has the first strength being lower than the predetermined strength. With this strength, the end part of the punch-processed sheet is not buckled when being abutted to the stopper plate but is buckled when being pushed by the push-out member at the predetermined speed. Accordingly, with the sheet of this combination, the sheet is discharged by the push-out member at the speed of being discharged from the intermediate process tray being lower than the predetermined speed (i.e., the second discharge control). Even in the case of the sheet hav-

ing 30 rectangular holes and length shorter than B4 (=364 mm), the sheet of plain paper or thick paper has the predetermined strength or higher capable of being discharged at the predetermined speed and the end part of the punch-processed sheet is not buckled. Accordingly, the sheet is discharged by the push-out member driven at the predetermined speed (i.e., the first discharge control).

Since the end part of the punch-processed sheet in the case of rectangular holes (i.e., the hole shape is square) as illustrated in FIG. **6**B is decreased compared to that in the case of circular holes as illustrated in FIG. **6**C even with the same 30 holes, the third discharge control is performed as described above.

Here, although the discharge control table is prepared with the combinations of three hole types of the punch die **854**, two sheet sizes and three sheet types, the combinations are not limited thereto. For example, it is also possible to classify the sheet types more finely by grammage and sheet length and to combine the types.

Next, the sheet discharge control of the finisher **800** will be described with reference to a flowchart of FIG. **11**. In the following description, the punch process information refers to combinations of information of sheet types, information of with-or-without performing punch process and information of punch holes.

In S**21**, when sheet passing is started, the finisher controlling portion **580** of the finisher **800** obtains sheet type information such as the sheet size and the sheet type which are set at the sheet selection screen of the operation displaying portion **600** of FIG. **4**A through the communication with the CPU circuit portion **150**. Then, it proceeds to S**22**.

In S**22**, the finisher controlling portion **580** (i.e., the CPU circuit portion **880**) of the finisher **800** obtains the information of with-or-without performing the punch process set at the sheet process selection screen of the operation displaying portion **600** in FIG. **4**B through the communication with the CPU circuit portion **150**. When the punch process is to be performed, it proceeds to S**23**. When the punch process is not to be performed, it proceeds to S**26** and the sheet discharge method is determined to be the first discharge control.

In S**23**, the information from the punch die reading controlling portion **873** is obtained and the hole types (the number, shape and size of holes) of the punch process to be performed are determined.

In S**24**, it is determined whether or not buckling occurs when stacking to the intermediate process tray **508** corresponding to the combination of the obtained sheet type, information of with-or-without performing the punch process and the punch hole type information. When the combination is not for causing buckling, it proceeds to S**25**. When the combination is for causing buckling, the sheet discharge method is determined to be the third discharge control, as proceeding to S**28**.

In S**25**, it is determined whether or not discharging in low speed for buckling prevention is necessary when the sheet is discharged from the intermediate process tray **508** corresponding to the combination of the obtained sheet type, information of with-or-without performing the punch process and the punch hole type information. If necessary to discharge in low speed, the sheet discharge method is determined to be the second discharge control, as proceeding to S**27**. If not necessary to discharge in low speed, the first discharge control as the sheet discharge method in the case of not performing the punch process is determined, as proceeding to S**26**.

With the abovementioned steps, an appropriate sheet discharge method is determined corresponding to the combination of the sheet type, information of with-or-without performing the punch process and the punch hole type information. Accordingly, appropriate sheet control is performed in accordance with strength decrease at the end part of the punch-processed sheet, so that buckling can be prevented at the end part of the sheet having decreased strength due to punch processing. In this manner, a sheet product on which a high quality punch process is performed can be provided to a user.

In the example of the above embodiment, plural types of punch processes can be performed with the configuration that plural types of punch dies **854** are exchangeable in one punch unit **700**. However, not limited to this, it is also possible to configure to actualize the plural punch processes by connecting plural punch units **700**, for example. Instead, it is also possible that plural types of punch dies (for example, 3 holes and 30 holes) are switchably disposed to one punch unit. Here, as the configuration to switchably dispose the plural types of punch dies, it is considered to dispose punch dies of 3 holes and 30 holes at a rotary member and to switch the punch die by rotating the rotary member.

Further, in the example of the above embodiment, the apparatus can perform the punch process with plural punch hole types. However, the punch hole type of the apparatus may be fixed to one type. In that case, the punch hole type to be obtained on the punch hole type obtaining process in S**13** and S**23** of the flowchart of the abovementioned sheet discharge control is simply to be a predetermined punch hole type. Then, subsequent steps to determine the sheet discharge method are kept the same.

Further, in the above embodiment, a black and white image forming apparatus is described as an example. However, not limited to this, a color image forming apparatus having plural image forming portions of different colors can be adopted.

Further, in the above embodiment, a copying machine is described as an example of the image forming apparatus main body of the image forming system. However, not limited to this, it is also possible to adopt another image forming main body such as a printer, a facsimile machine and a multifunction machine combining the functions thereof. Substantially the same effects can be obtained by applying the present invention to a sheet processing apparatus being combined with the abovementioned image forming apparatus main body.

Furthermore, in the example of the above embodiment, the sheet processing apparatus is detachably attachable to the image forming apparatus main body. However, the present invention is not limited to this. For example, the sheet processing apparatus may be integrated with the image forming apparatus main body. In this case, by applying the present invention to the sheet processing apparatus as well, substantially the same effects can be obtained.

While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all modifications, equivalent structures and functions.

This application claims the benefit of Japanese Patent Application No. 2009-161391, filed Jul. 8, 2009, and No. 2010-138829, filed Jun. 18, 2010, which are hereby incorporated by reference herein in their entirety.

What is claimed is:

1. A sheet processing apparatus comprising:

a punch portion which punches a hole at an end part of a sheet;

a sheet conveying portion which conveys the sheet, on which a punch process is performed by the punch por-

tion, by pushing the end part of the sheet where the punch process is performed by the punch portion; and

a controller which controls the sheet conveying portion,

wherein the controller controls the sheet conveying portion so that the sheet conveying portion conveys a sheet at a sheet conveying speed lower than a predetermined speed in accordance with punch process information indicating that a strength of a sheet end part is decreased by the punch process and is lower than a predetermined sheet strength of a sheet capable of being conveyed at the predetermined speed.

2. The sheet processing apparatus according to claim **1**, wherein the punch process information is a combination of a size and a type of the sheet and a number, a shape and a size of holes to be punched at the sheet end part.

3. The sheet processing apparatus according to claim **1**, wherein the controller controls the sheet conveying portion so that:

a sheet having circular holes punched at an end part thereof is conveyed by the sheet conveying portion at the sheet conveying speed lower than the predetermined speed in a case that a sheet length in the conveying direction is longer than a predetermined length, a sheet thickness is thinner than a predetermined thickness and a number of holes is more than a predetermined number, and

a sheet having rectangular holes punched at an end part thereof is conveyed by the sheet conveying portion at the sheet conveying speed lower than the predetermined speed in a case that a sheet thickness is thinner than the predetermined thickness and a number of holes is more than the predetermined number, even when sheet length in the conveying direction is shorter than the predetermined length.

4. The sheet processing apparatus according to claim **1**, wherein the punch portion is capable of selectively punching holes of different types by being provided with a plurality of detachably attachable blade portions having different hole types and by exchanging the blade portions.

5. The sheet processing apparatus according to claim **1**,

wherein the punch portion is capable of selectively punching holes of different types by switchably including a plurality of blade portions having different hole types and by switching the blade portions.

6. The sheet processing apparatus according to claim **1**, further comprising:

a first stack portion which is capable of stacking punch-processed sheets by the punch portion,

wherein the sheet conveying portion conveys the sheets stacked on the first stack portion toward a second stack portion by pushing the punch-processed end parts of the sheets.

7. An image forming system comprising:

an image forming portion which forms an image on a sheet;

a sheet processing portion which selectively performs a process on the image-formed sheet; and

a controller which controls the sheet processing portion,

wherein the sheet processing portion includes a punch portion which punches a hole at an end part of a sheet, and a sheet conveying portion which conveys the sheet, on which a punch process is performed by the punch portion, by pushing the end part of the sheet where the punch process is performed by the punch portion, and

wherein the controller controls the sheet conveying portion so that the sheet conveying portion conveys a sheet at a sheet conveying speed lower than a predetermined speed in accordance with punch process information that a strength of a sheet end part is decreased by the punch process and is lower than a predetermined sheet strength of a sheet capable of being conveyed at the predetermined speed.

8. The image forming system according to claim **7**, wherein the sheet conveying portion conveys a sheet against which a sheet alignment process is performed by striking the punch-processed sheet end part to an abutment member, and

wherein a lack of permission to perform the sheet alignment process by striking the punch-processed sheet end part to the abutment member is notified, in accordance with punch process information indicating that the sheet to be conveyed has a sheet strength, lower than the predetermined sheet strength, that causes buckling when the punch-processed sheet end part is struck to the abutment member.

9. The image forming system according to claim **7**,

wherein the punch process information is a combination of a size and a type of the sheet and a number, a shape and a size of holes to be punched at the sheet end part.

10. The image forming system according to claim **7**, wherein the controller controls the sheet conveying portion so that:

a sheet having circular holes punched at an end part thereof is conveyed by the sheet conveying portion at the sheet conveying speed lower than the predetermined speed in a case that a sheet length in the conveying direction is longer than a predetermined length, a sheet thickness is thinner than a predetermined thickness and a number of holes is more than a predetermined number,

a sheet having rectangular holes punched at an end part thereof is conveyed by the sheet conveying portion at the sheet conveying speed lower than the predetermined speed in a case that a sheet thickness is thinner than the predetermined thickness and a number of holes is more than the predetermined number, even when a sheet length in the conveying direction is shorter than the predetermined length, and

wherein a lack of permission to perform the sheet alignment process by striking the punch-processed sheet end part to the abutment member is notified with a sheet having rectangular holes punched at an end part thereof in a case that a sheet length in the conveying direction is longer than the predetermined length, a sheet thickness is thinner than the predetermined thickness and number of the holes is more than the predetermined number.

11. The image forming system according to claim **7**, wherein the punch portion is capable of selectively punching holes of different types by being provided with a plurality of detachably attachable blade portions having different hole types and by exchanging the blade portions.

12. The image forming system according to claim **7**,

wherein the punch portion is capable of selectively punching holes of different types by switchably including a plurality of blade portions having different hole types and by switching the blade portions.

13. The image forming system according to claim **7**, further comprising:

a first stack portion which is capable of stacking punch-processed sheets by the punch portion,

wherein the sheet conveying portion conveys the sheets stacked on the first stack portion toward a second stack portion by pushing the punch-processed end parts of the sheets.

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